

CLAIMS

1. An electrically operable brake drive for a vehicle having wheels, having braking apparatus for applying a braking force to at least one of the wheels to thereby set a brake of the vehicle and for reducing the applied braking force to thereby release the brake of the vehicle and having a force transmitting means for coupling the braking apparatus to the drive, said brake drive comprising:

a plurality of drivingly coupled and rotatable gears, one of the gears including coupling means for coupling one of the gears to the force transmitting means for setting and releasing the brake depending on the direction of rotation of said one of the gears;

an electrically operable motor with a rotatable and reversible drive member coupled to a gear of the plurality of gears and alternatively rotatable in a first direction for rotating the gears in the brake setting direction and in a second, opposite direction for rotating the gears in the brake releasing direction;

a detent mechanism coupled to the gears for preventing rotation of the gears in the brake release direction when the drive member is rotated in the first direction and for permitting rotation of the gears in the release direction when the drive motor is rotated in the second direction; and

an electrical control system for controlling the direction of rotation of the drive member for setting and releasing the brake without manual readjustment of the drive.

2. A brake drive as set forth in claim 1 wherein the plurality of gears comprises a drive gear coupled to the one gear for rotating the one gear and a rotatable drive shaft coupled to, and rotatable by, the electric motor drive member and coupled to the drive gear for rotating the drive gear and wherein the detent mechanism is coupled to said drive shaft by a drive shaft rotation direction dependent coupler which permits the one gear to rotate in the brake setting direction and prevents rotation of the one gear in the brake release direction when the drive shaft and the one gear are rotated in the brake setting direction but which permits the one gear to rotate in the brake release direction when the drive shaft is rotated in the brake release direction.

3. A brake drive as set forth in claim 2 wherein the drive shaft has a longitudinal axis of rotation and the drive shaft is coupled to the drive gear by cam means which causes the drive gear to move axially of the drive shaft in a first direction when the drive shaft is rotated in the brake setting direction and which causes the drive gear to move axially of the drive shaft in a second opposite direction when the drive shaft is rotated in the brake release direction and wherein the detent mechanism comprises a toothed ratchet gear rotatably mounted on the drive shaft and a pawl engageable with the teeth of the ratchet gear to prevent rotation of the ratchet gear in a first direction, axial movement of the ratchet gear on the drive shaft in the first direction of axial movement of the drive gear being limited, said drive gear being coupled to the ratchet gear when the drive gear moves in the axial first direction of the drive gear to cause the ratchet gear to rotate in a second direction with the drive shaft when the drive shaft is rotated in the brake setting direction whereby rotation of the drive gear and the one gear on the brake release direction is prevented but is permitted when the drive shaft is rotated in the brake release direction.

4. A brake drive as set forth in claim 2 wherein the electric motor drive member is coupled to the drive shaft by a releasable coupling which, when actuated, uncouples the drive member from the drive shaft.

5. A brake drive as set forth in claim 4 wherein the releasable coupling is manually releasable.

6. A brake drive as set forth in claim 5 further comprising a manually operable drive member coupled to the drive shaft for manually rotating the drive shaft for manually setting and releasing the brake.

7. A brake drive as set forth in claim 6 wherein the manually operable drive member is coupled to the drive shaft by a releasable coupling.

8. A brake drive as set forth in claim 7 wherein the releasable coupling for coupling the drive shaft is manually releasable.

9. A brake drive as set forth in claim 8 further comprising a manually operable member coupled to both the manually releasable coupling for coupling the drive member to the drive shaft and the manually releasable coupling for coupling the manually operable drive member to the drive shaft for alternatively coupling the drive member to the drive shaft and coupling the drive member to the drive shaft.

10. A brake drive as set forth in claim 9 wherein the manually operable drive member is a hand wheel.

11. An electrically operable brake drive for a vehicle having wheels, having braking apparatus for applying a braking force to at least one of the wheels to thereby set a brake of the vehicle and for reducing the applied braking force to thereby release the brake of the vehicle and having a force transmitting means for coupling the braking apparatus to the drive, said brake drive comprising:

- a plurality of drivingly coupled and rotatable gears, one of the gears including coupling means for coupling one of the gears to the force transmitting means for setting and releasing the brake depending on the direction of rotation of said one of the gears;

- a bi-directional, electrically operable motor with a drive member coupled to a second one of the gears for rotating said one of the gears in either the brake setting or brake releasing direction;

- a uni-directional detent mechanism; and

- a rotation direction dependent coupler for coupling a rotatable gear of the plurality of gears to the detent mechanism for permitting rotation of the rotatable gear in the brake setting direction and preventing rotation of the rotatable gear in the brake release direction when the drive member rotates the second one of the gears in the brake setting direction but permitting rotation of the rotatable gear in the brake release direction when the electric motor rotates the second one of the gears in the brake release direction.

12. A brake drive as set forth in claim 11 wherein the detent mechanism comprises:

- a ratchet gear for rotation in a first direction when the rotatable gear is rotated in the brake setting direction;

- a pawl engaging the ratchet gear and preventing rotation of the ratchet gear in a second, opposite direction and wherein the rotation dependent coupler comprises:

- a releasable coupling interconnecting the ratchet gear and the rotatable gear for rotation together when the rotatable gear is rotated in the brake setting direction and disconnecting the ratchet gear and the rotatable gear when the drive member rotates the second one of the gears in the brake release direction.

13. A brake drive as set forth in claim 1 wherein the electrically operable motor includes the drive member and the drive member direction of rotation depends upon the electrical energization of the motor and the electrical control system controls the energization of the motor.

14. A brake drive as set forth in claim 13 wherein the electrical control system comprises electronic components for supplying electrical energy to the motor causing the drive member to rotate in a first direction or in a second direction.

15. A brake drive as set forth in claim 14 wherein the electronic components are controllable by manually operable switches.

16. A brake drive as set forth in claim 14 wherein the electronic control system further comprises a limit switch coupled to the electronic components and operable when the brakes are at least substantially released to stop the electrically operable motor, the limit switch being operable by one of the one gear, the coupling means and the force transmitting means.

17. A brake drive as set forth in claim 14 wherein the current drawn by the electrically operable motor is dependent upon the rotation driving force supplied by the motor and wherein the electronic control system further comprises a source of electrical energy coupled to the motor for energizing the motor, a comparator circuit for determining when the current reaches a predetermined value, the comparator being coupled to the motor electrical source and to the electronic components for stopping the motor when the current reaches the predetermined value.

18. A brake drive as set forth in claim 14 wherein the brake drive further comprises a manually operable drive member for rotating said one gear, a manually operable coupler interconnecting the motor and the gears for mechanically and alternatively permitting the motor to rotate the gears and to prevent the motor from rotating the gears and a manually operable control member for operating the manually operable coupler and wherein the electrical control system further comprises a switch operable by one of the manually operable control member and the manually operable coupler and coupled to the electronic components for stopping the motor when the manually operable coupler prevents the motor from rotating the gears.

19. A brake drive as set forth in claim 18 wherein the switch is a proximity sensor switch responsive to the position of said one of the manually operable control member and the manually operable coupler

20. A brake drive as set forth in claim 1 wherein the electrical control system

comprises a receiver for receiving electromagnetic signals transmitted in free space and the received signals control the direction of rotation of the drive member.

21. The method of controlling the setting and releasing of a brake or a vehicle having wheels, having braking apparatus for applying a braking force to at least one of the wheels by the brake and having force transmitting means coupled to the braking apparatus, the method comprising:

- providing an electrically operable motor with a rotatable and reversible drive member;

- providing a plurality of drivingly coupled rotatable gears;

- providing a coupling between one of the gears and the force transmitting means for transmitting a braking force to the braking apparatus with rotation of the one of the gears;

- coupling the drive member to one of the gears for rotating the gears; rotating the drive member in a first direction to set the brakes and in a second direction to release the brakes; and

- providing a detent mechanism which is coupled to the gears and which in response to rotation of the drive member in the first direction prevents release of the brakes and in response to rotation of the drive member in the second direction permits release of the brakes.

22. The method as set forth in claim 20 wherein providing a detent mechanism comprises:

- providing a rotatable ratchet gear;

- providing a pawl engaging the ratchet gear which prevents rotation of the ratchet gear in a first direction but permits rotation of the ratchet gear in a second direction;

- providing a releasable coupling between the ratchet gear and one of the plurality of gears, the releasable coupling causing the ratchet gear to rotate in the second direction and with the last-mentioned one of the gears when the drive member rotates in its first direction to set the brakes and permitting the last-mentioned one of the gears to rotate independently of the ratchet gear when the drive member rotates in the second direction to release the brakes.